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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

New England Association of Gas Engineers.

SECRETARY'S OFFICE, LYNN, MASS., Jan. 11, 1893.

The Twenty-third Annual Meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Boston, on Wednesday and Thursday, February 15th and 16th. The first session will be called to order at 10 o'clock on Wednesday morning. A cordial invitation to be present is extended to the friends of the Association.

C. F. PRICHARD, Secretary.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND CLASS MATTER.

BRIEFLY TOLD.

A CHICAGO JUDGE AND HIS DIGNITY.—If Chicago is noted for one thing more than another, that thing is its great belief in its own dignity; and in attempting to impress other places and persons with its overpowering sense of importance, its clacking tongue is ever on the poise of repeating "I am; we are; thou art" not. When merciful time, through the natural mellowing process of ripening by age, has taught the bounding city of mid-America to be less mindful of its importance, Chicago will probably not be so frequently in the market for hiring brass bands to resonantly announce her greatness, her superiority, her dignity. Having in time acquired a greater proportion of all these sustaining qualities, the possession of them will, while it will not detract an iota from her growth, have accustomed her to their refining influences, with the result that the merits of her graces will not require frantic and repeated expression to teach her neighbors that these graces are of her and in her. It is commonly believed that the Courts of the land are clothed with dignity, more or less, the fineness of the texture of the raiment varying with the location in which it is worn; and we all have supposed that the Courts of Chicago had, for instance, a greater share of the fine raiment than the Courts of Oklahoma Territory. Whether so or not, we report to-day a case in our item columns, the scene of which is laid in a Chicago temple of justice, the outcome of which would, we submit, sadly rend the dignity raiment of an Oklahoma temple of judicial pronouncements. Tersely stated, the case was like this: The Neufield Manufacturing Company, of Chicago, which had been a consumer of gas supplied by the Peoples' Company arm of the Gas Trust, became involved in difficulty, and the latter was serious enough to call for the appointment of a receiver to extricate it from its entanglements. Up to the time of the appointment of the receiver the debt of the Company for gas supplied amounted to something over $20. Under the rule provided by the city ordinances for the purchase and sale of gas, the Gas Company, on the receiver's assumption of his duties, applied to him for a settlement of the account, coupled with the request that the usual formalities consequent on the taking on of a new consumer be entered into. The receiver demurred, asserting that the old gas debt would have to take its chance of eventual settlement with the other debts overhanging the concern, and he also refused to make the customary deposit and give the usual bond required between a *new* consumer and the Gas Company. Taking him at his word, the Gas Company cut out the meter, and prepared, under the statutes so provided, to collect by due process of law the old debt, or so much thereof as might be recovered from the final balance resulting from the collection of assets and the payment of debts. Gas light was a necessity to the carrying on of the Neufield Company's trade, whereupon the receiver hurriedly appealed to one Judge Horton for an order requiring the Gas Company to restore the gas supply. That legal luminary, inflating himself, till, what with wind and dignity, the bench fairly creaked, at once resolved to cut the gordian knot with swift directness. The Court had appointed a receiver and the Court's appointee could not earn his fees to their fullest without the aid of gas; but the Company had cut off the gas—and in cutting off the gas it had wounded the dignity of the appointing power—in fact, had committed a veritable assault on justice

itself. Judge Horton announced that he could not enter an order requiring the Company to turn on the gas, but that he would authorize the receiver "to take a wrench and turn on the gas." Very much the same as though a thug said to his victim, I know I have not the faith that you will give me, as my right, your purse for the asking, but I will, with a blow from this trusty bludgeon, take it from your pocket by virtue of the power that is in the stick. And, added the Judge, "We will see whether the Gas Company is greater than this Court." The most ridiculous part of the anomaly is that the Court, whose duty it was to see that neither the right of the receiver nor the safety of the Gas Company was put upon, coolly puts his own self will as the weight to turn the scale, despite the plain fact that the Company was only acting in strict conformity with the ordinances which "the Court" was paid to construe without fear or favor. The receiver was in the plainest sense a *new* customer for the Company, and the latter would not have cut off the gas supply had the receiver not refused point blank to make the necessary agreements always required between a gas company and those it is about to regard as new consumers. Had the Gas Company declined to keep up the gas supply, following the professed acquiescence of the receiver to, as a new consumer, meet the things prescribed of a new consumer, on the ground that the bills in default of the *old* consumer must be settled as an added requisite, the matter would be quite different. Although even those complete conditions are exacted in respect of the gas taken from the municipal gas works of Philadelphia, where gas bills due from the former owner or tenant of a premises are a bar to the supply of gas to such premises until payment has been made, no matter by whom. In the meantime, Judge Horton's dignity remains ruffled.

THERE MAY YET BE SOMETHING OF A GAS EXHIBIT AT THE WORLD'S FAIR.—It looks very much that, after all, something worthy of the name of a separate exhibition of gas at the coming World's Fair will be accomplished; and, appropriately enough, the scheme has taken shape through the efforts of the Managers of the Woman's Department. Mrs. Palmer, whose skill and finesse are well backed by influence and brainy methods, is and has been greatly interested in the general subject of improved systems of cookery; and as the mention of this naturally brings to mind the best fuel as an adjunct, or even the very basis of the best system, we have gas at once before us. Mrs. Palmer, acting in conjunction with Mrs. Stranahan, of Brooklyn, and others of the sex, have determined that there shall be a model cooking school on the Fair grounds, and have asked Miss Juliet Corson, of this city, who is so well known to the gas men from her continued, common-sense and successful teaching of the merits of gas as a fuel for the kitchen, to take charge of the practical details of the same—that is, to plan out the practical scope and plan of the school. It is rather early yet to say anything definite about the matter, but it can be positively stated that there will be a model cookery school somewhere on the exhibition grounds, that it will be managed by Miss Corson, and that the sole fuel used will be gaseous, even, as Miss Corson remarks, "if it has to be carried to Chicago in cylinders." We hope to have something more definite about the movement in our issue for next week.

NOTES.—The proprietors of the Freehold (N. J.) Gas Light Company held a meeting last week that partook of the nature of a self-admiration circle. Nor were any of the ordinary incentives thereto lacking. The shareholders received 6 per cent. interest on their stock for the year; the works had been very much enlarged and improved; the output had increased 30 per cent. for the twelvemonth, and the output for purposes other than illuminating was returned at one-third of the entire sendout. Not only so, but a 10 per cent. reduction in the rates had been granted. The proprietors evidently concluded that their Manager, Mr. Charles A. Bennet, Jr., was largely responsible for this state of affairs, for, having voted to virtually double his salary, they elected him to the vacancy in the Directorate caused by the death of Major Henry Bennet. The other members chosen to the Board were Messrs. David V. Perrine, Chas. A. Bennet, Chas. B. Ellis and Frank B. Conover. In further evidence of its soundness the Company voted to put 4 per cent. on the capital into sinking fund.——The San Francisco Gas Light Company has declared a dividend of 35 cents per share, payable from January 16th. The Company's annual interest return at this rate (which is monthly) amounts to 4.20 per cent.——On one day this month the aggregate cash receipts of the office of the City Gas Works, Wheeling, W. Va., amounted to something over $5,000.——It is announced that Mr. Henry Craft, for many years in control of the gas supply of Batavia, N. Y., has sold his interest in the Consolidated Gas and Electric Light Company, of that place, and will retire from the business.——Messrs. H. Wadsworth, Thos. Quinn, A. R. Burford, F. S. Dodge, J. L. Jones, C. Ennis and C. E. Burrows have been elected Trustees of the Walla Walla (Wash.) Gas and Electric Light Company.

[Continued from page 76.]

Generation of Light from Coal Gas.

[The second of a series of four Cantor Lectures, delivered by Vivian B. Lewes, F.I.C., F.C.S., before the English Society of Arts.]

Leaving the brilliant work of Sir Humphry Davy and the lesser lights who followed in his wake, we come to the labors of another giant in our scientific world, one who is happily still with us, and whose work needs no posthumous halo to make it alike remarkable for its power, brilliancy, and the wideness of its scope.

Dr. Edward Frankland, whose researches were made first in the laboratories of Playfair, Bunsen, and Liebig, and afterwards at Queenwood, Owen's College, St. Bartholomew's, the Royal Institution, and the Royal College of Chemistry, has left, in the same way that Davy did, his stamp upon all he attempted. Whether working upon the isolation and identification of the radicles of which organic compounds are built up, and the evolution from them of new and unknown compounds, or employed upon the more practical investigations on water, sewage, and gas, with which his name is so closely identified, or in his studies on physical science, which served to make still pleasanter his vacations, Frankland threw into the researches his heart and soul, and has given us a record of work which is remarkable for the way in which he has not only disclosed to us new facts, but has attempted in every case to discover the principles underlying them.

In the August of 1859 Dr. Frankland, in company with Professor Tyndall, undertook an ascent of Mont Blanc, with the object of establishing thermometric stations between Chamouni and the summit of the mountain, and, at the same time, seized the opportunity of trying some experiments on the rates of the combustion of candles at high altitudes, in order to verify the accuracy of a statement made by Le Conte, that "the process of combustion is retarded by diminution of the density of the air, whilst it is accelerated by its condensation."

Burning six candles for one hour at Chamouni, Dr. Frankland carefully noted the loss of weight for each, and again repeated the experiment for one hour on the summit of Mont Blanc.

The average diminution in weight for each candle was 9.4 grams per hour when burnt at Chamouni, and 9.2 when burnt on the summit of the mountain; and the close agreement of these results, under such widely differing circumstances, naturally suggested to his mind that the rate of burning of substances which require the oxygen of the air to support their combustion is entirely independent of the density of the atmosphere.

Whilst watching the burning of the candles in the tent which had been erected on the summit of the mountain, Dr. Frankland was struck by the small amount of light which they emitted, and the way in which the non-luminous zone of the flame had extended its proportions to the detriment of the luminous zone.

Later on in the year Dr. Frankland repeated these experiments under conditions which allowed of photometric measurement of the amount of light given by the candles under diminished pressure, and the results are best given in his own words:

"The result proved that a great reduction in illuminating effect ensues when a candle is transferred from air at the ordinary atmospheric pressure to rarefied air. At the same time remarkable changes in appearance occur in the flame itself, especially at high degrees of rarefaction. During the diminution of the pressure down to half an atmosphere, the chief alteration is the gradual invasion of the upper and luminous portion of the flame by the lower blue and non-luminous part. As the pressure sinks toward 10 inches of mercury, the retreat of the luminous portion of the flame toward the apex goes on uninterruptedly, but the shape and color of the flame also begin to undergo very remarkable alterations—the summit becomes more and more rounded until at 10 inches pressure the flame assumes nearly the form of an ellipse, whilst the blue portion, which now comprises nearly the whole flame, acquires a peculiar greenish tint. Finally, at 6 inches pressure, the last trace of yellow disappears from the summit of the flame, leaving an almost perfect globe of the peculiar greenish-blue tint above mentioned. Just before the disappearance of the yellow portion of the flame there comes into view a splendid halo of pinkish light, forming a shell half an inch thick around the blue-green nucleus, and thus greatly enlarging the dimensions of the visible flame. The color of this luminous shell closely resembles that first noted by Gassiot in the stratified electrical discharge passing through a nearly vacuous tube containing a minute trace of nitrogen. The color thus imparted to the electrical discharge undoubtedly constitutes the most delicate test of the presence of nitrogen. In both cases I believe the colored light to be due to incandescent nitrogen.

"In attempting photometrical determinations with candles, it was found that, owing to the irregularities of combustion, no satisfactory quantitative experiments could be made in artificially rarefied air. Oil lamps also proved equally unsuitable, owing to the gradual ascent of the base of the flame toward the apex of the wick, by which the size of the flame and the hourly consumption of the oil were greatly diminished. Recource was therefore made to coal gas, which, although liable to certain minor disturbing influences, yet yielded results, during an extensive series of experiments, exhibiting sufficient uniformity to render them worthy of confidence."

From the results of these experiments Dr. Frankland deduced the following important law:

"Of 100 units of light emitted by a gas flame burning in air at a pressure of 30 inches of mercury, 5.1 units are extinguished by each diminution of one mercurial inch of atmospheric pressure, or, more generally, the diminution in illuminating power is directly proportional to the diminution in atmospheric pressure."

As a natural sequence to these experiments he made a second series upon the effects of compressed air upon the luminosity of similar flames.

"At the very outset of this part of the inquiry considerable difficulties presented themselves, since it became necessary to abandon a gaseous combustible, which could not be compressed to the necessary degree, and then delivered at a uniform pressure through a burner without very complex apparatus. I was thus compelled to resort to solid or liquid combustibles, the irregularties of which were still further increased by the space within the combustion chamber being necessarily more confined, in order that its walls might the better sustain high pressures. These difficulties in the way of accurate determinations, however, were by no means the most formidable, for it was soon found that any considerable increase of atmospheric pressure caused both candle and oil flames to throw off large quantities of fuliginous matter, the formation of which could not be prevented by any amount of draught that could be established in the chimney of the apparatus. Hence, although the luminosity of the flames was greatly increased, yet it was obviously much less so than would have been the case under conditions of more perfect combustion. In fact, it soon became evident that the determination of increase of luminosity by compression must be made in a manner precisely the reverse of that employed for the corresponding determinations in rarefied air, for, whilst in the latter case the experiments were made with flames which, at ordinary atmospheric pressure, were saturated with luminous matter, in the former it was found necessary to commence with flames which were very feebly, or not at all, luminous at common pressures. Such is the effect of compressed air in determining the precipitation of carbon particles within the flame that a small alcohol lamp which, at the ordinary pressure burnt with a pure blue flame, became highly luminous when placed under a pressure of four atmospheres, and it can scarcely be doubted that, at a pressure of 5 or 6 atmospheres, its luminosity would be equal to that of sperm oil burning at atmospheric pressure.

Owing to these difficulties, I have only been able to obtain satisfactory determinations between 1 and 2 atmospheres. In these determinations the lamp was supplied with amylic alcohol, a liquid which, whilst affording an appreciable amount of light in the experimental flame under 1 atmospheric pressure, was found to burn under two atmospheres without smoke, although at a somewhat higher pressure it began to evolve fuliginous matter.

The results of the experiments approximate to those calculated from the law given for pressures less than that of the atmosphere, but when continued to still higher pressures results were obtained which differed very widely from those one would have expected.

In discussing the probable causes of these and other slight variations from the law, Dr. Frankland says:

"The luminosity of the flames generally used for artificial light emanates from two sources, viz., first from the ignition of minute particles of carbon floating in the shell of the flame, and, secondly, from the incandescence of gaseous matters. The latter source of illumination probably does not furnish more than 1 per cent. of the total amount of light, consequently nearly the whole of the light given out by flames under ordinary circumstances is due, as Davy first pointed out, to the ignition of solid carbonaceous matter."

This shows that at this time (1861) his views of the cause of luminosity in flame were in accord with Davy's, and he finally sums up the influence of atmospheric pressure upon the combustion as follows:

"1. The rate of burning of candles and other similar combustibles, whose flame depends upon the volatilization and ignition of combustible matter in contact with atmospheric air, is not perceptibly affected by the pressure of the supporting medium.

"2. The luminosity of ordinary flames depends upon the pressure of the supporting medium, and, between certain limits, the diminution in illuminating power is directly proportional to the diminution in atmospheric pressure.

"3. The variation in the illuminating power of flame by alterations in the pressure of the supporting medium depends chiefly, if not entirely, upon the ready access of atmospheric oxygen to, or its comparative exclusion from, the interior of the flame.

"4. Down to a certain limit, the more rarefied the atmosphere in which flame burns, the more perfect is the combustion."

It was in the June of 1861 that Frankland contributed these important observations to the Royal Society, and seven years later he published a still more important communication in their "Proceedings"—a paper in which he shows that flames like those of hydrogen or carbon monoxide in oxygen, which cannot possibly contain solid matter, yet can be made to emit light when burning under sufficiently high pressure. In this paper, which was read on June 11, 1868, he says:

"Further, experiments, made more than a year ago, on the nature of the luminous agent in a coal gas flame, led me to doubt the correctness of the commonly received theory first propounded by Sir Humphrey Davy, that the light of a gas flame, and of luminous flames in general, is due to the presence of solid particles. In reference to gas and candle flames, it is now well known that the fuliginous matter produced when a piece of wire gauze is depressed upon such flames, and the sooty deposit which coats a piece of white porcelain placed in a similar position, are not pure carbon, but contain hydrogen, which is only completely got rid of by prolonged exposure to a white heat in an atmosphere of chlorine. On pursuing the subject further, I found that there are many flames possessing a high degree of luminosity which cannot possibly contain solid particles. Thus the flame of metal arsenic burning in oxygen emits a remarkably intense white light, and as metal arsenic volatilizes at 180° C., and its product of combustion—arsenious anhydride—at 218° C., whilst the temperature of incandescence of solids is at least 500° C., it is obviously impossible here to assume the presence of ignited solid particles in the flame. Again, if carbonic disulphide vapor be made to burn in oxygen, or oxygen in carbonic disulphide vapor, an almost insupportably brilliant light is the result. Now fuliginous matter is never present in any part of this flame, and the boiling point of sulphur, 440° C., is below the temperature of incandescence, so that the assumption of solid particles in the flame is here also inadmissible. If the last experiment be varied by the substitution of nitric oxide gas for oxygen, the result is still the same, and the dazzling light produced by the combustion of these compounds is also so rich in the more refrangible rays, that it has been employed in taking instantaneous photographs, and for exhibiting the phenomena of fluorescence.

"Many other cases of the production of brilliant light from incandescent, gaseous, or vaporous matter might be cited, but I will mention only one other. Amongst the chemical reactions celebrated for the production of dazzling light, there are few which surpass the active combustion of phosphorus in oxygen. Now, phosphoric anhydride, the product of this combustion, is volatile at a red heat, and it is therefore manifestly impossible that this substance should exist in the solid form at the temperature of the phosphorus flame, which far transcends the melting point of platinum. For these reasons, I consider that incandescent particles of carbon are not the source of light in gas and candle flame, but that the luminosity of these flames is due to radiations from dense but transparent hydrocarbon vapors.

"As a further generalization from the experiment above mentioned, I was led to the conclusion that dense gases and vapors become luminous at much lower temperatures than aeriform fluids of comparatively low specific gravity, and that this result is, to a great extent if not altogether, independent of the nature of the gas or vapor, inasmuch as I found that gases of low density, which are not luminous at a given temperature when burnt under common atmospheric pressure, become so when they are simultaneously compressed. Thus, mixtures of hydrogen and carbonic oxide with oxygen, emit but little light when they are burnt or exploded in free air, but exhibit intense luminosity when exploded in closed glass vessels, so as to prevent their expansion at the moment of combustion.

I have recently extended these experiments to the combustion of jets of hydrogen and carbonic oxide in oxygen under a pressure gradually increasing to 20 atmospheres. These experiments were conducted in a strong iron vessel, furnished with a thick plate of glass of sufficient size to permit of the optical examination of the flame. The results are so remarkable that, although still far from being complete, I venture to communicate them to the Royal Society before the close of the session. The appearance of a jet of hydrogen burning in oxygen under the ordi-

nary atmospheric pressure is too well known to need description. On increasing the pressure to two atmospheres, the previously feeble luminosity is very visibly augmented, whilst at 10 atmospheres' pressure the light emitted by a jet about 1 inch long is amply sufficient to enable the observer to read a newspaper at a distance of two feet from the flame, and this without any reflecting surface behind the flame. Examined by the spectroscope, the spectrum of this flame is bright and perfectly continuous from red to violet.

"With a higher initial luminosity the flame of carbonic oxide in oxygen becomes much more luminous at a pressure of 10 atmospheres than a flame of hydrogen of the same size and burning under the same pressure. The spectrum of carbonic oxide burning in air is well known to be continuous; burnt in oxygen under a pressure of 14 atmospheres, the spectrum of the flame is very brilliant and perfectly continuous."

This paper, striking as it did at the root of the fundamental ideas existing as to the causes of luminosity in flame, caused a profound sensation, and it was not long before the interest taken in it was made manifest by criticisms and attacks upon the new theory put forward.

One of the first of these was by W. Stein (*Journal fur Pract. Chemie*, 2 viii. 401), who, in criticising the various points in Frankland's paper with regard to the observation that the soot deposited from a luminous flame is not pure carbon but contains hydrogen, points out that:

"The first objection to this is that, as is well known, not only do all heavy hydrocarbons decompose with deposition of carbon at a high temperature in absence of air, but even marsh gas itself does so. Since now the hydrocarbons, whose vapors are supposed to produce the luminosity, are under such conditions before they are reached by the oxygen of the air, it cannot be doubted that they must undergo a decomposition in the luminous part of flames into carbon and hydrogen. Whether the separated carbon is chemically pure, or whether it is mixed with a body containing hydrogen, is of slight importance, since the chief question with which we are concerned is whether the soot is present in the flame as vapor or in the solid state. If it were a conglomeration of the densest light producing hydrocarbons, whose vapors condense on the cold body, then it must, when strongly enough heated in absence of air, again be vaporized. This, however, is not the case as every one will find who tries the experiment. Moreover, its chemical composition is just as little favorable to Frankland's view. This will presumably vary according to the different luminous material from which the soot is obtained, and also according to the position in the flame from which it is taken. For the temperature of flame is, as is well known, different at different points, and as known from the researches of Magnus, at lower temperatures, in addition to carbon, a tarry product containing hydrogen, separates from the hydrocarbon. The soot, of which I give an analysis below, was collected from a gas flame by sinking the bottom of a small silver kettle filled with water, 2 to 3 mm. deep into the flame. Benzine extracted from it traces of a solid yellow body, which, on account of its small quantity, could not be further examined. Nothing was extracted by alcohol, alcoholic potash, and dilute sulphuric acid. After careful and continued washing with boiling water and drying at 130°, 0.206 gave 0.6985 carbonic acid, 0.0195 water, 0.0020 ash. This amounts to:

		Or on Ash Free Substance.
Carbon	96.446 per cent.	97.390 per cent.
Hydrogen	1.051 "	1.061 "
Ash	0.970 "	— "
Oxygen	1.533 "	1.549 "

The oxygen which it contains must, I think, be ascribed to a small quantity of water being left in it even after drying at 130°. If this be deducted, then the water and ash free substance consists of 99.905 carbon and 0.905 hydrogen. This analysis consequently confirms that view of the chemical composition of the soot of flames, which is based on the known behavior of hydrocarbons at high temperatures."

And again—

"In order to show that this view of the luminosity of vapor is not without examples, Frankland points to the luminosity which takes place on burning arsenic, phosphorus and carbon bisulphide in oxygen gas at the ordinary pressure, and hydrogen and carbonic oxide at an increased pressure, since in these cases the co-operation of solid particles cannot come in question. However valuable and interesting this all may be from a scientific point of view, it does not in any way prove that the process in our luminous flames must be an analogous one, since the well-established fact that solid bodies are specially adapted for becoming radiant is not altered by it, and up to the present only one solid body has been discovered to which one could ascribe the luminosity of these flames. When, therefore, all that has been stated is considered no other conclusion can be arrived at but that the light of our luminous flames comes from incandescent particles of carbon, and that therefore the old view is the true one,"

About this time Knapp showed that the luminosity of a coal gas flame could be destroyed not only by admitting air, as in the Bunsen burner—which up to this time had been supposed to destroy luminosity by the more rapid combustion of the carbon particles—but also by burning the coal gas with inert gases, such as nitrogen and carbon dioxide, which could take no part in the combustion, a phenomenon explained by Wibel as being due to the cooling effect of these gases upon the flame, as luminosity may be restored by heating the mixture of gases just before combustion.

These views were criticised by Dr. Karl Heumann in "Liebig's Annalen," vols. clxxi. and clxxx., as well as Frankland's work, concerning which he says:

"Frankland has broached the hypothesis that the luminosity of flame is not due to particles of suspended carbon, but is caused by the vapors of heavy hydrocarbons which radiate white light. Strong positive evidence in support of a view so much at variance with the generally accepted theory, could hardly be expected, and Frankland has relied principally upon the fact that we are acquainted with many luminous flames in which we cannot suppose that solid matter is present.

"To the instances already known Frankland has added the interesting observation that hydrogen and carbon monoxide when burned in oxygen under a pressure of 10 to 20 atmospheres, yield a luminous flame affording a continuous spectrum, and also that the faintly luminous flame of alcohol becomes as bright as that of a candle when the pressure is increased to 18 or 20 atmospheres. These experiments are not so convincing as might at first sight appear, inasmuch as we know that the temperature of the flame is increased at high pressure, and also at the temperature of the electric spark many gases yield a continuous in place of a line spectrum. The power of gases as regards emission of light also varies considerably under these circumstances, and it does not appear that we are absolutely necessitated, as Frankland has supposed, to ascribe the increase in luminosity to the increased density of the gas, although doubtless this circumstance is not without considerable influence.

"The inquiry as to the nature of hydrocarbon flames is quite independent of the meaning which we may attach to these appearances, and if Frankland puts forward the above cited phenomena of combustion as analogies to guide him in views concerning carbon flames, no very forcible argument can be really deduced from the examples, because, as W. Stein has pointed out, it cannot be shown that the reaction in luminous carbonaceous flames must be an analogous one to that described above.

"Frankland's declaration that the soot must be regarded as an accumulation of heavy hydrocarbons, whose vapors are condensed on the cold body brought into the flame, may be regarded as almost confuted by Stein's objection, that in this case the soot must become gaseous at higher temperatures, which is not the case."

And then going on to Wibel's conclusions points out that:

"Everyday experience tells us that the blue flame of Bunsen's burner, as well as that of the blow pipe, possesses a much higher temperature than the ordinary luminous flame; but if Wibel be correct in saying that decrease in luminosity is a consequence of cooling only, then, logically, the temperature of the luminous flame ought to be higher than that of the non-luminous flame."

He then attacks the various problems which the Bunsen flame gives rise to, and finally concludes that—

"When air destroys the luminosity of a coal gas flame, there are at least three causes, each of which is capable of decreasing the luminosity of these flames, viz., withdrawal of heat, dilution, and oxidation of the luminous material.

"In most cases two or more of these causes are at work; in non-luminosity brought about by nitrogen and carbon dioxide, especially dilution and heat absorbtion; in the widening out of a flame caused by a cold surface absorbtion of the heat, and a more rapid oxidation of the carbon; and in non-luminosity caused by air each of the three causes is at work.

"The flame of a Bunsen's burner appears to be the final product of a whole series of causes, acting some in one direction, some in another, and it is not to be wondered at that observers of luminous flames have arrived at such diverse and contradictory conclusions, inasmuch as they have made the study of this flame their principal object, overlooking the great complexity of the conditions affecting it, instead of preceding such a study by an investigation of more simple instances of combustion."

He then fully discusses the effect of cooling upon the combustion in flames, and comes to the following important conclusions:

"1. The fact that a gas flame does not rest upon the burner nor candle flame upon the wick, as also the fact that a flame never directly touches a cold body held within it, is to be explained by the cooling action exercised upon the gas by its surroundings.

"When the combustible gases are cooled throughout a definite space below their ignition temperature, the flame is extinguished.

"2. The very considerable distance noticed between the burner and the flame of a gas issuing under high pressure, or mixed with a large volume of an indifferent gas, is to be traced to the cooling action of the stream of gas and of the outer air, and perhaps more especially to the fact that the velocity of the stream of gas in the neighborhood of the burner is greater than the velocity of propagation of ignition within the gas."

In a second paper, published in the "Annalen," clxxxiii., "On the Influence of Withdrawal from, and Addition of Heat to, Luminous Flames," several points are discussed, the author finally pointing out—

"A cold object brought into a luminous flare causes a suspension of the process of combustion in its immediate neighborhood, and, at the same time, very materially diminishes the luminosity throughout a considerable space around itself.

"Carbon-containing luminous materials may burn with or without separation of carbon—that is, with or without luminous flames—according as a certain temperature, differing for each material, is or is not maintained. Combustible material which has been diluted with indifferent gases requires to be maintained at a higher temperature, in order that it shall burn with a luminous flame, than when it is not so diluted.

"The fact that soot is deposited on a cold object held in a luminous flame is no proof of decreased temperature within the flame, inasmuch as it has been shown that decreased temperature causes a diminution in the quantity, or even total suppression of the separated carbon.

"Soot is also deposited on heated surfaces, but is quickly burned on admission of air. Inasmuch as admission of air cannot be altogether prevented, less soot is accumulated on hot than on cold objects.

"Burners constructed of iron or other material possessed of high conductivity for heat, cause a greater diminution in the luminosity of the lower part of the flame than burners of steatite. The difference between the luminosities of the two flames is rendered more apparent by artificially cooling the burner.

"The top of the burner and the entering cold gas both exert a cooling action upon the lower part of the flame, and are the cause of the space noticeable between the burner and the flame mantle. By heating the burner and simultaneously the stream of gas, a more luminous flame is obtained without an increased consumption of gas, the increase in luminosity being greater the smaller is the consumption of gas.

"The change which is hereby caused in the chemical composition of the gas is without appreciable effect upon the luminosity, inasmuch as no diminution in luminosity is occasioned by again cooling the stream of gas.

"The heat communicated by increasing the temperature of the burner tube acts in two ways; it increases the intensity of the light of the flame mantle, and simultaneously enlarges the flame itself. Carbon is also sooner separated in the flame, and separated at a higher temperature."

His most valuable contribution to the question of whether luminous hydrocarbon flames contain solid particles or not, is to be found in volume clxxxiv. of the "Annalen," in which he shows that—

"1. Chlorine causes an increase in the luminosity of feebly luminous or non luminous hydrocarbon flames. Inasmuch as chlorine decomposes hydrocarbons at a red heat, with separation of carbon, it follows that the increased luminosity is due to the production of solid carbon particles.

"2. A small rod held in the luminous flame becomes rapidly covered on its lower surface—the surface exposed to the issuing gas—with a deposit of soot. The solid soot is evidently driven against the rod. If the soot were present as vapor in the luminous flame, its deposition would be due to a lowering of the flame temperature, and would therefore take place on all sides of the rod.

"3. A strongly heated surface also becomes covered with a deposit of soot. This would not be possible if the deposit were the result of the cooling action of the surface upon the flame.

"4. The carbon particles present in the luminous flame become visible when the flame is caused to rush against another flame, or against a heated surface. The separated particles are rolled together into larger masses, so that the luminous mantle becomes filled with numerous glowing points. The soot of such a flame is very coarse grained.

"5. The luminous mantle of a flame is not altogether transparent; the thicker the flame layer, and the greater the number of solid particles contained therein, the less transparent does it become. The transparency of a luminous flame is no greater than that of the—approximately—equally thick stratum of soot which rises from the flame of burning turpentine, and which is universally allowed to contain many solid particles. A luminous flame of hydrogen, containing solid chromic oxide, is as transparent as the hydrocarbon flame.

"6. Those flames which undoubtedly owe their luminosity to the presence of finely divided solid matter produce characteristic shadows when viewed in the sunlight. The only luminous flames which do not produce true shadows are those which consist of glowing vapors and gases. Luminous hydrocarbons produce strongly marked shadows in sunlight; these flames, therefore, contain finely divided solid matter. That this solid matter can be nothing but carbon is evident from the fact that other substances, capable of remaining solid at the temperature of these flames, are absent.

"These proofs are, I think, sufficient to convince every one that the luminous flames of the hydrocarbons actually contain solid carbon particles."

This splendid contribution to the carbon particle theory of luminosity in hydrocarbon flames, was further strengthened by researches made by Soret (*Philosophical Magazine*, 1875), who showed the existence of solid particles in a luminous hydrocarbon flame, by focussing the sun's rays upon the luminous portion of the flame, and examining the light reflected by it by the aid of a Nicol's prism. Burch, also, in 1885, did the same thing in a very similar way. Whilst demonstrating to his landlady that the sun's rays did not extinguish the fire, but only prevented the light emitted by the glowing embers being seen, he was struck by the power of the sunlight in overcoming the light emitted by even highly incandescent bodies, and found that on focussing the sun's rays on a flame a spot of light was visible on the highly luminous mantle of the flame, and the reflected light from this gave ample evidence, when examined by the spectroscope, of the presence of solid particles. Quite lately, also, Sir George Stokes has come to the same conclusion, by experiments of the same character.

I have this evening brought before you the one celebrated attack upon Davy's theory, and the further evidence which it brought forth, and I confess that to my mind the facts are so overwhelmingly in favor of Sir Humphry's original assumption as to the cause of luminosity in hydrocarbon flames, that although Dr. Frankland undoubtedly showed that solid matter was not a necessity for a luminous flame, yet we must admit that in the special class of flames we are considering, the light-giving power is practically entirely dependent on their presence. It must, however, be borne in mind that Dr. Frankland himself is in no way shaken in his opinion, and we may all hope to hear further proof of his theory.

Whilst the physical aspects of luminosity were being studied in this way, there had not been wanting attempts to attack the question from a chemical point of view, and the researches of Dr. Hilgard, Landolt and Blochmann have done much towards enlightening us as to the chemical changes taking place in hydrocarbon flames; but as the facts demonstrated by their work fit in best with the theories I shall have to bring before you next week, a discussion of their results will be better reserved until then.

The Changing of the Physical Properties of Coke Made in the Bye-Product Ovens.

In a note on this topic, Mr. James J. Fronheiser says that the greatest fault found in Europe, and more particularly in England, with the coke made in the bye product ovens, was on account of its greater softness, in consequence of which, at the proper temperature, too much of it was wasted in the upper part of the blast furnace by being dissolved, as it were, by the escaping carbonic acid, thus: $CO_2 + C = CO$.

On p. 287 of Sir I. Lowthian Bell's *Manufacture of Iron and Steel*, we find the following:

"Hard coke, soft coke and charcoal pounded as near as possible to the same size were placed in a hard glass tube which they filled, and were then raised to a good, red heat in a Hofman's double furnace. During the space of 30 minutes, 800 cc. of carefully dried carbonic acid was passed over each specimen. The issuing gases had the following volumetric composition:

	Hard Coke.	Soft Coke.	Charcoal.
Carbonic acid	94.56	69.81	35.2
Carbonic oxide	5.44	30.19	64.8
	100.00	100.00	100.00

Now, in order to correct the bad properties of soft coke, we recently

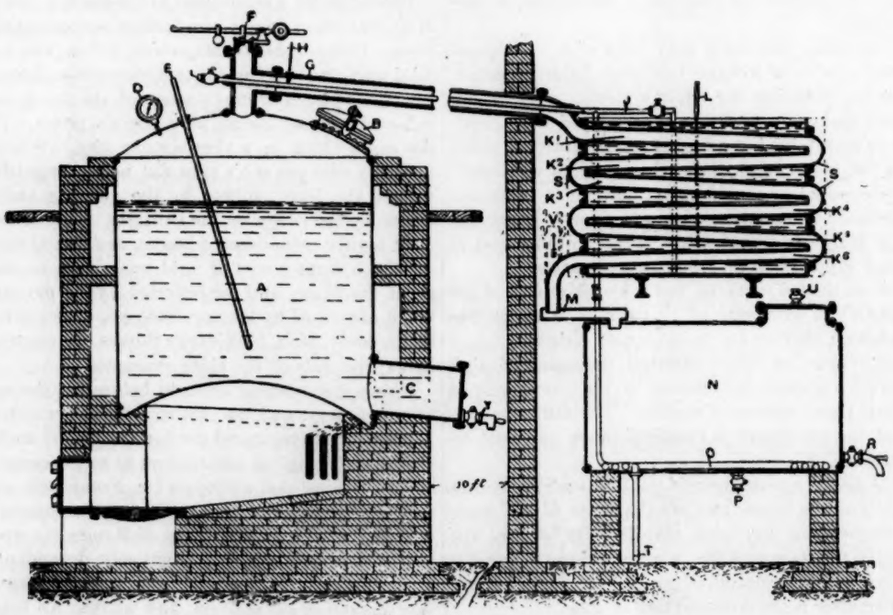
tried some experiments with the same kinds of coal (Connellsville), coked it in a bee hive oven under different conditions, and found by submitting the resulting coke to the same conditions used by Mr. Bell, the following results:

	Prepared Coke.	Ordinary Coke.	Charcoal.
Carbonic oxide.....	8.72 cc.	43.76 cc.	217 cc.

Proving that under certain conditions the same coal can be treated so as to furnish harder coke than by the ordinary treatment, thereby overcoming the disadvantages charged to the coke made by the bye-product ovens.

The Producing of Pure Naphthaline.

Industries, in describing a process for the manufacture of pure naphthaline, says that about 5 tons of crude naphthaline obtained from the fractional distillation of coal tar is placed in the still *A* together with 30 lbs. of 70 per cent. caustic soda, which has previously been made into a solution of strength 70° Twaddell. The still is 7 ft. in diameter and 7 ft. deep. The manhole cover is then closed and the fire applied. At first and until the temperature rises to 210° C., water vapor and oily matters come off. When these have finished, the heat is raised to 235° C., at which temperature the naphthaline vapor comes off. The vapors pass off through the pipe *G*, and go to the condensing coil *K*. Here the naphthaline is condensed to the form of a hot liquid, and in that state runs down the shoot *M*, in a cylindrical receiver *N*. Before the naphthaline commences to come off, and while the watery vapor and oily matters are escaping, the receiver *N* is not in its place. This tank is fitted with a steam pipe *O* to keep the contents liquid. Before describing the further treatment of the partially purified naphthaline thus obtained, it is necessary to point out some of the details of the still *A* and coil *K*. The still has a dished bottom inclining toward the mud hole *C*. There is an emptying tap *Y*, a pressure gauge *D*, a pocket to carry a thermometer *E*, a safety valve *F*, and a thermometer *H* in the pipe *G*. There is a steam pipe *I J* placed down the center of *G* to prevent condensation; this is rendered necessary because the still and condenser have to be placed in separate buildings to minimize risk from fire.



In the next part of the process the liquid naphthaline in *N* is thickened to the consistency of mortar by the admixture of ground naphthaline residues from previous operations. The paste is transferred to strong bags and pressed while still hot in a hydraulic press. The pressure is as great as 3 tons per sq. in., and it is sufficient to express all oily matters. These oily matters are collected and used as liquid fuel. The naphthaline is left as a hard, grayish cake, which, when struck, emits a ringing sound.

This "pressed material," as it is called, is charged into another still of similar construction to the first, and about a hundred weight of best thirds commercial sulphur is added. The mixture is distilled as before and under the same conditions. The first runnings are kept separate and are afterward used in working up succeeding tankfuls of liquid naphthaline. A considerable quantity of sulphureted hydrogen gas is evolved in this distillation, and is drawn off at the end of the coil *K*, through the pipe shown in dotted lines *V* into a box fitted with wire gauze baffles to prevent the naphthaline from following the gas. From this box the gas passes to the chimney or to an oxide of iron absorber. The naphthaline collects in a receiver, and it is kept liquid for a period of 12 to 24 hours. Then it is forced by compressed air into a third still of precisely the same construction as the two previous ones. Here it is mixed with 50 lbs. of 70 per cent. caustic soda in the form of a 70° Twaddell solution. This mixture is distilled as before. The caustic soda in this distillation reacts at a temperature less than 160° C.; so in order to prevent the reaction from reversing itself at a higher temperature, the fire is drawn as soon as the temperature reaches 165 C., the contents allowed to settle for an hour and the caustic soda and impurities drawn off at *Y*. Then the distillation is again proceeded with. The finished naphthaline is run off into 100 lb. galvanized iron cans and allowed to solidify, after which the blocks are broken into small pieces. The naphthaline is of the highest purity, and its melting point is 79 2°-79.5 C., free from oily matters and suitable for the preparation of naphthols and naphthylamines.

Comparison of the Eschka and Hundeshagen Methods of Estimating Sulphur in Coal and Coke.

Mr. James O. Handy, of the Engineers' Society of Western Pennsylvania, has prepared a brief on the matter noted in the heading. He writes:

Eschka's method (Pittsburgh Testing Laboratory practice): One gramme fine coal, 1 gramme pure MgO (Baker and Adamson's), and 1 gramme C. P. Na^2CO^3 (Baker and Adamson's) are mixed thoroughly and heated in a 100 c.c. platinum dish over a Bunsen burner. Begin with flame just touching dish. Raise heat till in 15 minutes the dish is red hot. Stir frequently with a platinum wire until carbon has burned away. Let cool. Brush contents of dish into a 200 c.c. beaker, add 100 c.c. of water, 15 c.c. of bromine water, and boil for five minutes. Filter and wash well with hot water. Make filtrate up to 250 c.c., add HCl until just acid, and boil off bromine; precipitate with $BaCl^2$ as usual. $BaSo^4 \times .13756 = S$. No sulphur has been found in B. and A., MgO or Na^2CO^3, and no correction is required. This method has been used by us practically in the present form for the past four years, and has given satisfaction.

Hundeshagen's method, as described in *J. A. and A. C.*, vol. vi., No. 7, p. 385, is essentially as follows: One gramme of coal and 2 grammes of a mixture of 2 parts pure MgO and 1 part pure K^2CO^3 are placed in a platinum dish and mixed. The remaining operations are practically the same as described above under Eschka's method. In our experiments on samples of coal from different sources we obtained the same

results by the Eschka (E) method and the Hundeshagen (H) method. We noticed no greater rapidity of burning in the "H" than in the "E" process.

Sulphur in Coal.

(Comparison of Eschka and Hundeshagen processes.)

No.	Source.	Fixed Carbon. Per Cent.	Volatile Matter. Per Cent.	Sulphur by "E." Per Cent.	Sulphur by "H." Per Cent.
10,170,	Westmoreland county...	55.18	33.40	1.17	1.19
10,516,	Pittsburgh vicinity.....	52.92	30.90	1.66	1.67
10,517,	Pittsburgh vicinity.....	57.37	31.62	1.77	1.77
8,825,	Unknown.....	48.83	35.88	6.185	6.190
9,394,	Chartiers.....	54.48	36.30	1.268	1.266
9,395,	Youghiogheny.....	54.46	35.32	1.948	1.952

Fitch's Gas Making Apparatus.

On January 10th, 1893, U. S. Letters Patent (No. 489,472) were granted to Mr. Charles L. Fitch, of Brooklyn, N. Y., for an "improved method" of making gas, which the inventor thus describes in his specification:

The invention relates to an improvement in the process of manufacturing gas in which a supply of water gas is enriched by the combination therewith of a supply of hydrocarbon gas. A practical apparatus adapted to the carrying out of this process is represented in the accompanying drawings, in which—

Figure 1 is a view of the apparatus in elevation, Fig. 2 is a vertical central section, and Fig. 3 is a top plan view.

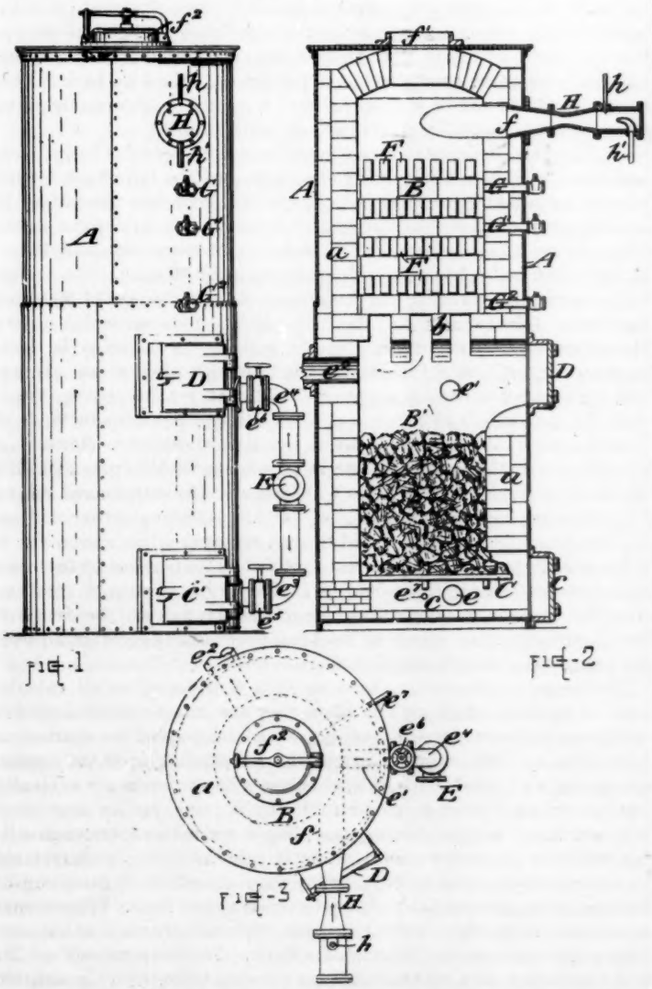


Fig-1 Fig-2

Fig-3

A represents an exterior casing, here shown as formed of metal and of a vertically elongated cylindrical form. The casing is provided with a lining *a*, and comprises an upper compartment *B* and a lower compartment *B*¹, which freely communicate with one another through a skeleton dome *b*, which forms the ceiling of the lower compartment and a supporting base for the material in the upper compartment. The lower compartment is provided with a grate *C*, ash pit *c* and door *c*¹ opening thereto. It is also provided with a door *D* for the entrance of the fuel, an opening *e* beneath the grate for the entrance of air, another opening *e*¹ above the fuel for the entrance of air, and a gas outlet opening *e*² above the fuel. Branches *e*³ and *e*⁴ of a common air supply pipe *E* connect with the openings *e* and *e*¹ and are provided with cocks or valves *e*⁵ and *e*⁶ for regulating the flow of air to either the lower or upper portion of the compartment *B*¹, as may be desired. Steam may be applied beneath the grate through an opening *e*⁷. The upper compartment *B* is partially filled with refractory material *F* and has an opening *f* in its upper portion for the reception of the hydrocarbon. The said upper compartment is further provided with an opening *f*¹ at the top for the escape of the smoke and gases in "blowing up," the said opening having a cover *f*² for closing it air tight when the manufacture of the gas takes place, and sight tubes *G*, *G*¹, *G*² are located at different heights throughout the upper chamber and extended from its exterior to the outside of the casing.

The tube for spraying the hydrocarbon into the chamber *B* is represented by *H*, the hydrocarbon being admitted thereto through a pipe *h* and a steam jet pipe *h*¹ being arranged to inject the hydrocarbon into the chamber in the form of spray.

The process may be particularly described as follows: A fire having been started in the lower chamber *B*¹ and a supply of coal having been placed therein, the cover *f*² is opened, the cock *e*⁶ closed, the supply of hydrocarbon and steam shut off from the sprayer and a blast of air admitted beneath the grate through the opening *e*. After the fire is started, the cock *e*⁶ may be opened to admit air to confine the gases in the fire chamber and expedite the heating. This "blowing up" process will heat the refractory material in the upper chamber to a glow, and when the latter is sufficiently heated, the cover *f*² is closed, the blast of air cut off or reduced to a slight amount, steam admitted beneath the grate through the opening *e*⁷ and the supply of hydrocarbon and steam opened to the sprayer. The steam from beneath the grate is converted into gas, and forms with the products of combustion a supply of water gas in the lower chamber above the fuel. The hydrocarbon spray passing down through the hot refractory material is converted into a fixed rich illuminating gas, and, as such, mixes with the water gas in the upper portion of the lower chamber and becomes thereby reduced to a commercial gas of great brilliancy, which, after passing through the outlet opening *e*², may be washed and stored as is usual. It will be observed that by the above process the hydrocarbon gas is fixed before it mixes with the water gas, and its candle power may be regulated with great precision, while the amount of nitrogen may be kept at a minimum. When the refractory material becomes cooled to a degree too low for effective results, it may be again raised to the required temperature by again "blowing up."

The inventor claims: The process of forming a fixed illuminating gas consisting in heating a converting chamber by passing the products of combustion through it from a bed of incandescent fuel, introducing a fine spray of hydrocarbon and steam into and passing it through said converting chamber in a direction opposite to that in which the products of combustion pass through it, thereby forming a fixed hydrocarbon gas, and simultaneously with the passage of the hydrocarbon spray through the converting chamber, passing steam through the bed of incandescent fuel employed in heating the converting chamber, thereby forming a water gas which mingles at the surface of the incandescent fuel with the hot hydrocarbon gas as it escapes from the converting chamber to form an illuminating gas without further fixing, substantially as set forth.

Redgrave's Flexible Metallic Tubing.

Mr. Gilbert Redgrave, in a paper before the British Association, explains that for many years inventors have attempted to find a metallic substitute for the ordinary india rubber tubing. The first flexible metallic tube was made of a number of annular segments, fitting into each other in such a way that a small amount of play was allowed for the two surfaces to slide over each other. Then many methods were tried by building up a tube by spirally winding a corrugated strip of metal, and allowing a similar amount of play between each convolution. Both of these kinds of tube presented the disadvantage inherent in all joints, consisting of sliding surfaces; that is, the difficulty of making the joint airtight and watertight. In order to make the joint perfectly airtight, inventors then inserted small strips of india rubber between the convolutions. This had, of course, the desired effect, but the india rubber strip was found to be exceedingly perishable, and the tube was in other ways just as open to objection as the plain india rubber tube. Inventors then had recourse to other devices, such as the combination of several layers of metal wires, the strands of each fitting into the re-

cesses of the others. Some of these designs have met with more or less success, though none can be said to be quite satisfactory. It has been left to a French inventor, M. Le Vavasseur, to make a perfectly satisfactory flexible metallic tube. He experimented for years with almost every conceivable form of tube, but eventually succeeded in getting a quite simple design to give eminently satisfactory results. The tube is built from a single strip of metal, previously corrugated in a special manner, and spirally wound on itself. There is no packing whatever between the convolutions, and yet the tube will withstand ordinary steam pressure for an indefinite period. A cross section of a wall of the tube is shown in Fig. 1. It will be seen that the strip has two channels formed in it, one larger than the other, and that the larger channel of one convolution overlaps the smaller one of the next convolution. The smaller channel is also much narrower than the larger one, so that considerable play is allowed between each convolution. Engineers and mechanics have been at a loss to account for the strength of the tube and its perfect airtightness, and several theories have been advanced,

for it is remarkable that this design should be so successful with M. Le Vavasseur after it had failed to give satisfactory results before. Whatever may be the cause, the result is without doubt, for the tubing has been in use in all sorts of installations for some time, and has made good all its inventor's claims and promises. Special machinery of high order has been designed for the manufacture of the tubing. It is made in one continuous operation from a ribbon of tough steel. The weight of a $\frac{5}{16}$ in. tube is 2½ oz. per ft.; a ¾ in. tube weighs 8½ oz. per ft., and a 1 in. tube weighs 11 oz. per ft. A ¼ in. tube is made from a strip of metal 0.6 mm. thick and 14 mm. wide.

The industrial application of such a tubing depends first on the degree of its flexibility, and, secondly, on its capability to resist the attacks of the fluid conveyed through it. The metal tubing is naturally much less flexible than any india rubber, but its strength and durability are immensely superior. It is capable of withstanding far greater internal pressure, and it is able to transmit suction, which the rubber tube cannot do. Then, again, it is not injured so much by bodies passing over it and falling on it; it can also bear weights hanging on it. It has many advantages over a solid metal pipe. For instance, it does not burst under frost, for its joints allow of sufficient contraction and expansion.

This form of flexible metallic tubing has been used with great success for conveying compressed air to rock drills; for carrying steam under 150 lb. pressure; for supplying Pintsch gas to railroad cars, at 200 lb. per sq. in. pressure, and in beer engines, speaking tubes, organ blowing machines, carpet cleaning machines, etc. It has also been applied successfully as a sheathing for electric wires and small cables.

With a tube of this sort, it is necessary that there should be some means of making a good and secure joint or coupling. This has been done by a simple screw connection—Fig. 2—the end of the tube being inserted into a conical cup, into which it is fastened by white lead or solder.

A simple push-on connection may be used for gas. For a strong joint for low pressure a plain collar made in halves and capable of being bolted round the junction with a packing of india rubber is all that is required, as in Fig. 3.

The Diffusion of Light in Rooms.

It is a satisfactory thing, remarks the *Journal of Gas Lighting*, that the problems of light and lighting are just now attracting marked attention on the part of independent workers in science; the latest proof of this renewed interest of scientific men in a class of subjects that has suffered undeserved neglect of late years being a paper on "The Diffusion of Light," recently read by Dr. W. E. Sumpner before the Physical Society. An abstract of this paper will be found elsewhere, but we propose here to discuss the subject generally, with reference to its bearing upon the use of artificial lights. Dr. Sumpner's paper was a very learned essay in applied mathematics, and little good would be served by our publishing it in full. Those who are sufficiently interested in the matter to follow up the methods by which this author has attempted to fix definite values to phenomena not wholly unfamiliar to working photometrists may be referred to the original text as it will appear in the Society's *Journal*.

Dr. Sumpner has found it necessary to begin his work with some definitions of terms, as every one must do who seeks to concentrate his ideas upon certain mutual relationships of quantities in a science which is afflicted with many loose and some irrational terms. We may accept his definition of the reflecting power of a surface as "the ratio of the amount of light reflected by it, to the total amount of light incident upon it." Also, it is understandable that the illumination of a surface is "the amount of incident light per unit area of the surface." But when Dr. Sumpner comes to the definition of the unit quantity of light, we get it as "the flux of radiation across a unit area of a sphere of unit radius at whose center a unit light is placed." This is correct; but it is hardly so obvious as could be desired of a definition. Then it follows that the total quantity of light emitted from a source is $4 \pi k$; the coefficient k being the candle power of the source. Here we have the old anomaly of one candle giving the total quantity of 12.6-candle light, which is mathematically correct and actually absurd.

Dr. Sumpner proceeds to investigate the part played by diffusion from walls and ceilings in the lighting of a room; and he brings out the important truth that the illumination due to this secondary source may be far more considerable than that caused by the direct rays of the lights. This relation between the radiation from a light source and the diffusion of light from walls, has been well brought out by Mascart. The present author seeks an expression for the average reflective power of inclosing surfaces of different reflecting capacity; and he finds one which is very approximately true for ordinary rooms, and may be shown to be quite accurate for a spherical inclosure. Dr. Sumpner takes as an average case for rooms a reflecting power of 70 per cent. for the ceiling, 40 per cent. for the walls, and 20 per cent. for the floor, when the increase of illumination by reflection becomes as much as 70 per cent. (These data should be taken into consideration in connection with the practical rules for lighting given by Mr. W. H. Y. Webber.) If the walls and ceiling of a room are well whitewashed, the average reflecting power will not fall far short of 80 per cent.; and in such cases the illumination due to diffused reflection is four times as important as that caused by the direct action of the lights in the room. A further great advantage resulting from the selection of good diffusing surfaces arises from the fact that the illumination they give is in most cases very nearly constant all over the room, and does not cast shadows.

The foregoing observations tend to show how deceptive all calculations of lighting effect may be when they are unaccompanied by due references to the nature of the ceiling, walls and floor of the apartments intended to be illuminated. Computations depending upon the proportion of light afforded to the cubical contents of the room are evidently misleading, since what would be sufficient lighting for an apartment with a polished or light-colored floor, bright walls and a whitened ceiling, would be altogether unsatisfactory in case the ceiling were replaced by a dark wooden roof, to say nothing about the effect of panelling or deep-toned paper upon the walls and carpets on the floor. The presence or absence of directly reflecting surfaces, such as mirrors, also has a serious influence upon the lighting of a room. The same remark applies to the spreading of a white cloth upon a dining table, with the addition of plenty of sparkling silver and crystal, and to the effect of covering a ball room floor with almost white "dancing holland."

The problem of successfully lighting a room is naturally affected by the uses to which the apartment is likely to be put. It is a problem that is also answered differently at different epochs. During the early Victorian period, the ideal of good lighting was universal glare. Even for drawing rooms the style of lighting and decoration described in "Jane Eyre" as a mixture of snow and fire, meaning the conjunction of glistening white walls and ceilings with crimson rugs, Bohemian glass lus-

ters, etc., was regarded as the height of elegance. It is a pity, from the electricians' point of view, that the new order of arc lamps did not come into use while these ideas of interior decoration prevailed. One can very well understand that a few arc lamps would have been esteemed the very thing for a cheerful apartment decorated and upholstered after the "snow and fire" model. Unfortunately for themselves, the triumph of the electricians did not come until the fashion in decoration had veered round to the opposite extreme. Instead of white walls, glittering ceilings and big mirrors reflecting lights to infinity, the last quarter of the present century saw a revival of the fancy for gloom and mistiness in the decoration of interiors. Until very recently no lady or gentleman who pretended to "taste" would have a reception room painted or papered in anything but some somber tint of sage green. Whitened ceilings were looked upon with horror, all decoration was in tertiary tones of color, and dull panelling and dingy tapestry were worshipped with a devotion that was all the more intense for being unreasoning.

It is really no easy matter to effectively light an apartment deliberately rendered dingy by darkening the ceiling and banishing every reflecting surface from the walls. People who went crazy over panelled chambers, and made every room as frowsy and dull as possible by reverting to wall hangings of severe aspect, forgot that the present generation wants to read, and sew, and see people's faces after nightfall, which the earlier races who had recourse to tapestry as a means of correcting the chilliness of stone walls never felt the necessity of doing. Consequently, these darkened apartments had to be lit upon a scale altogether unknown to the originators of the style of decoration; and then the trouble began. The "snow and fire" style of rooms was horribly lacking in that restfulness which constituted the only charm of the later fashion—a charm not to be despised in proper places; but at least they were easy to light. It was a strange room that could not be finished off satisfactorily, in and about the forties and fifties, by a crystal or a crystal and gold "chandelier" of the well remembered type. Where are those chandeliers now?

And it must be borne in mind that the system of lighting by massed lights which was exemplified in the chandelier, was perfectly consonant with the light tone of the prevailing fashion of decoration. To be shadowless was the great distinction for rooms decorated and lit in this fashion. Light was everywhere; and the glory of the central luminary —itself as shadowless as construction of the most transparent material could make it—was diffused from every plane bounding the illuminated enclosure. Peoples' eyes were dazzled upon their entry into such an apartment; but this effect was actually desired. Everything was to be sparkling, *eclatant*, astonishing. Repose? For this one would have been directed to the sleeping apartments. In the reception rooms, people were expected to keep their eyes open; and, if the dazzling radiance of every object caused the pupil to shrink to a pin-point, and showed the iris at its widest, so much the better.

With the return of dark colors on walls, ceilings, and floors, the days, or rather the nights, of the chandelier passed away. Massed lights were patently out of place where there were no means of diffusing their effect. People did not use chandeliers because the greatest amount of light was wanted in the middle of the room, or wherever the chandelier might happen to hang, but only because a certain quantity was necessary, and it might as well be had "in the lump," so to speak, as otherwise. Wherever it originated, there would be no difficulty about its diffusion. When the reflecting walls and ceiling had vanished, it became necessary to distribute the lights where they were wanted. In a word, the local effect had to be considered, instead of the general appearance. Of course, it was possible to make a room look very pretty when lit up by scattered lights. The addition of shadow and of *chiar'oscuro* to the decorator's resources was a noteworthy reinforcement; but the effect was no longer the same. The use of powerful light sources fell out of favor for reception rooms; and reading and writing were done by isolated lamps.

The fashion of dimness never invaded ball rooms or places of public assembly for various reasons. A dingy ball room is almost a contradiction in terms; and an auditorium must not be made gloomy on peril of inducing sleep on the part of the occupants. A change has come over the lighting of theaters, however, during those post-Wagnerian days; the proscenium being much more markedly the center of illumination than was formerly customary. And it was with no small satisfaction that we are able to report that the tyranny of sage green in the decoration of domestic interiors is overpast. Now-a days, a man who likes brightness in his drawing room may have it without reproach. Tender pinks, blues, and sea greens are to be seen once more in reception rooms and boudoirs; while pale yellows and broken whites are asserting their claims only too strenuously for householders who cannot afford to refurnish in a new "key" every few years. The result of this revulsion of fashion in regard to lighting is clear. It will lead to a revived demand for massed lights and for light sources of comparatively high illuminating power. All things being equal, it is obviously more convenient to have one light in a room instead of two; and so it will be found when restored means of diffusion render the extreme subdivision of lights no longer neeessary. But it is not to be believed that the early Victorian "chandelier" will ever return to favor among householders with any pretension to taste. We all know that impostor of a chandelier, with its sham oil reservoirs containing nothing, and all its working parts pretending to be something different from their true office. Never has there been seen anything more hideous than this chandelier, except the sham candles of the modern electrician stuck into imitation Oriental vases. Massed lights are certainly coming in again; but they will not be in the same shape as of yore. So wonderful is Fashion, which, even in repeating itself, does so "with a difference" quite sufficiently marked to prevent the cast off style of one period from being furbished up anew. We are not sorry that circumstances are once more rendering it incumbent upon lighting specialists to take account of the effects of reflection from surfaces which have been deprived of this quality at the dictates of an arbitrary mode. Gas lends itself well to illumination in the mass; and with the return of a liking for cheerfulnesss in the night aspect of living rooms, the popularity of the most cheerful of lights must necessarily increase.

Locating Trouble on Arc and Power Circuits in Central Station Work.

[A paper read by Mr. C. O. Poole before the California Electrical Soc.]

As the title of this paper indicates, its object is to deal with the process of locating trouble on overhead construction in arc and power transmissions, rather than to suggest remedies or attempt to improve the line work. There is an old saying that "if a fellow looks for trouble he is sure to find it very quickly." While this may be true when said of a man armed with a club looking for his neighbor's dog, it does not hold good when applied to a lineman armed with a pair of spurs and magneto bell, looking for an open circuit, or a short circuit, or a ground, or a cross, as the case may be. And it is by no means a pleasant undertaking, when the customers, whose lights are not burning, are making the telephone wires hot, and the Superintendent's heart sad with these questions and complaints: "What is the matter with our light?" "Will it be going soon?" "Is anybody else's light out?" "Is this likely to occur again?" "What is the reason it don't burn?" "I have tried the broom handle and it don't do any good; there must be something the matter with the lamp; send a man down to repair it." The Superintendent will have to reply to this torrent of questions with all the suavity at his command, and present explanations and apologies sufficient to satisfy any man other than one whose place of business has been left in darkness several hours because the linemen, with their spurs and magneto bell, and hampered with rubber coats and gum boots, had been unable to find the cause of the annoyance on a circuit 15 to 20 miles long, and consequently those 50 or 60 lights, if 9:30 lights, did not burn that night; or if 12 o'clock or all night lights, they did not burn until late in the night.

It is of such cases as these, which are by no means uncommon, that I wish to speak. I am aware that many means have been employed for testing purposes; but most of them have been too complicated, or too expensive or unreliable, or for some other cause have been discarded, and the old reliable magneto bell looms up in all its greatness.

When a lineman is sent out on a circuit to find trouble, he knows three things: First, the circuit he has to go out on; second, that there is a ground, a cross, a short circuit, or an open circuit; and last, but not least, that if he does not find it in short order he will hear from the Superintendent.

If it be an open circuit and he has the advantage of working in daylight, the first thing he does is to ground both legs of the circuit at the switchboard in the station,; then, with an assistant, go to the first convenient lamp on the circuit, open the circuit at the lamp, ground one side of his magneto bell and test both ways toward the grounded ends in the station. Suppose he is working at the first lamp on the positive leg, he tests that wire back to the station and fails to get a ring; he knows then that the open circuit is between the station and where has made the test. He then traces the circuit back toward the station until he finds the break. If, however, he should get a ring when he tests the positive wire toward the station, he then tests the other end of the wire, and, finding it open, continues his search in that direction until he passes the break and gets a ring on the negative leg; he then knows, of

course, that the point lies between the last place of testing and his present position.

If a circuit should open at night during the run, the following method is sometimes used to advantage: The lineman instructs the dynamo tender to leave the machine on the circuit; he then arms himself with a pair of spurs and a short piece of wire, and for once the magneto bell is not in it. His knowledge of the circuit enables him to soon reach a pole where both legs of the circuit are on the same cross-arm. Buckling his spurs on he quickly mounts the pole, and, baring the circuit wires, brings into service the short piece of wire before mentioned, with which he strikes both of the circuit wires. If a flash is the result, he knows that he has to go further out on the circuit. After climbing another pole some distance further on, and going through the same process of striking the wires, and failing to get a flash, he concludes, of course, that the trouble lies between the first and second test. As soon as the broken ends are reached and spliced together the lights immediately start up. That is one advantage of having the machine on the circuit, while there is the disadvantage of working with the machine that is liable to jump at you with about 2,000 or 3,000 volts, which is by no means a pleasant thing to handle on a wet night.

In order to overcome this danger, and to allow him to become a little more sociable with the circuit he is working on, the Company I am with has had constucted a machine to put on this circuit, instead of the regular arc machine; the boys call it the "jigger." It is simply a combined motor and dynamo connected together on the same shaft. It is placed on a roller platform, and stands in the corner of the station until wanted. The motor is wound for 10 amperes, constant current, and has a capacity of about 2 horse power. The dynamo is wound for constant potential, with an output of about 15 amperes at 200 to 300 volts. When required, the motor part is connected in the arc circuit and is run up to speed. The dynamo terminals are connected to a suitable plug, and a plug put in the circuit that is open. You will readily understand, if the wires be short circuited as before mentioned, a current will immediately be generated and a flash will be the result.

Not knowing of any better methods than the ones above described for locating a break in the open circuit, I cannot offer any suggestions that would be of benefit. Of course, if the wire should break, and one or both ends fall to the earth and make a fairly good ground, you would, by means of the Wheatstone bridge and galvanometer, be able to make an intelligent guess, that is all. There are so many doubtful points to be considered in measuring lamp circuits that it makes a calculation almost worthless. For instance, if you had to depend upon the path through the carbons of a lamp, the resistance may be a fraction of an ohm, or it may be 10 ohms. Again, if the carbon be burnt out in a lamp that depends upon the current to keep the cut-out in contact, then you would have to deal with the resistance of the shunt winding, which would amount to 200 or 300 ohms.

Another element of uncertainty that might be mentioned is that of induction. I remember one case in particular. After personally going over all the lamps on the circuit, which was about 15 miles long and consisted of No. 6 B. & S. wire, I attempted to measure it with the bridge and galvanometer. I found it impossible to get a satisfactory reading. One instant 30 or 40 ohms would almost balance, and the next instant it would take 400 or 500 ohms to bring the needle to anything near a standstill, while in the next instant it would be found down at zero, with the negative sign before it. The bridge was one of the best, and the galvanometer a Thomson reflecting instrument; both having been previously tested and found correct. The only way that I could account for the phenomena was in the fact that for some distance the lines ran parallel on the same pole with a live circuit. So, everything considered, in my opinion the bridge and galvanometer is not a satisfactory method of testing lamp circuits. I will say, however, in this connection, that in some few cases by the use of the bridge I have determined the position of grounds and short circuits on trunk lines and on circuits where the trouble occurred between the station and the first or last lamp.

In instances of this kind, the uncertainty of lamp measurements need not be taken into consideration, and the question resolves itself simply into a matter of measurements and calculations. As an example, suppose the trunk line of No. 6 B. & S. wire be two miles long, and the wire becomes short circuited at an unknown distance from the station. If on measuring it you find the resistance to be 4.176 ohms, and upon referring to a table of resistances you find the resistance of one mile of No. 6 wire to be 2.088 ohms; dividing 4.176, the measured resistance of the circuit, by the resistance per mile of wire, 2.088, the result will be 2; meaning, of course, that the wire measured was two miles long, and the circuit, consisting of two wires, would make the distance from the station to the point of trouble just one mile. If the short circuit had been caused by two grounds, their position could have been determined by the same process as just described; the only difference being to connect one post of the bridge to one side of the line and the other to ground. Then if you found a resistance of 2.088 ohms, and considering the ground resistance to be nil, you would know at once that the ground on that side of the circuit would be one mile from the station; assuming, of course, that the measurements be made in the station. After getting your distance, and telling the linemen where to find the trouble, it is a matter of but a few minutes until the circuit is clear, and there is light once more. Now, if the linemen had not been told where to find the trouble, and simply to go out and find the short circuit, it would have been necessary to trace the wires from the station until the place of trouble was reached; or by taking the magneto he could have cut the wires and tested both ways. This might have to be repeated several times; and, aside from the disadvantage of having a line full of splices, would have taken much longer to locate the trouble.

We have seen how an open circuit and short circuit are located. Now let us follow the linemen in locating crosses between two circuits. Suppose No. 2 and No. 3 to be crossed. The first thing to be done is to test for a ground. If either of the circuits is grounded it must be found and cleared before the cross can be considered. If the circuit be free from grounds, one of the circuits in question is then grounded in the station, say No. 2 be the one; then with the magneto bell he starts out on No. 3 circuit. The process is similar to that described in finding an open circuit so far as the method of testing is concerned; the difference between the two lies in the fact that in the first case you are trying to find the reason you do not get a ring, and in the second case the reason you do get a ring. After proceeding to a lamp on No. 3 circuit, and taking the wires out of the binding posts of the lamp, one side of the magneto is grounded, by connecting a wire to a convenient water pipe or gas pipe, or if the earth be moist by driving a screw driver into the ground and connecting to that; then with the other side of the bell, the lineman can connect the line wire and test toward the station. If he gets a ring, the point of contact betweeh the two circuits, of course, lies between the station and the place of testing. This will be apparent if you bear in mind the fact that No. 2 circuit is grounded in the station, and when the ground is made on one side of the bell it is equivalent to connecting it to No. 2 circuit, and the only reason the connection is not made to the circuit direct is because it may be a mile or more distant.

Having dealt with the open circuit and short circuit, and a cross; now let me take up that root of trouble, the "ground." I will venture the assertion that nine-tenths of the outside trouble in central station work is either directly or indirectly traceable to grounds, and if there be any central station men present this evening, I believe they will bear me out in the statement.

Where the lineman is called upon to clear one cross, he has nine calls for grounds, and it is equally true regarding open circuits, although short circuits are frequently found to consist of two grounds. I will recite an instance of this a little further on. If I treat the subject of grounds a little more fully than the others, I do so for two reasons. First, because it is of more importance than any of the others, on account of the more frequent occurrence; second, because it offers an opportunity to use instruments in locating the trouble. The instrument I use is a voltmeter, reading from 0 to 3,000.

The magneto bell method of locating a ground is the same as the one described, that of opening the circuit and testing both ways. With the voltmeter, it is necessary, of course, to make the test while the circuit is running. I have found it a good practice to go over all the circuits at the switch board with a ground wire while the lamps were burning. In this way I have frequently detected grounds on a circuit where other methods had pronounced them all right. If, upon striking a circuit with a ground wire, you succeed in drawing out a flash about a yard long, and probably have to take two steps backward to break it, you will have a kind of a foggy idea that there is a ground on that circuit, and if, upon examination, you find half your mustache and one eyebrow gone; and it has taken about 10 minutes to recover your eyesight, then you feel pretty sure that you have found a ground circuit.

For the benefit of the uninitiated, I will say that this singeing process will occur but once; for the next time the neophyte approaches a live circuit with a ground wire, it will be with a 10 foot pole, and the wire safely fastened at the proper end of it.

Having found a grounded circuit, the next thing to do is to find the ground on the circuit. If there be but one ground on the circuit, it will make no difference with the burning of the lights; but if there is one ground there is sure to be another sooner or later, and then the trouble

begins. For this reason, and several others that might be mentioned, it is desirable to keep the lines clear of grounds at all times.

But returning to our problem of locating grounds, we will take the circuit from which comes the flash, for example call it No. 10, and in handling it, treat it with all the respect and deference due its importance. First, with the voltmeter, take the electromotive force across the terminals on the switchboard ; do not be satisfied with one reading, but take several at intervals of two or three minutes, for the voltage of an arc circuit is anything but constant. Suppose the average for several readings be 2,500 volts. By turning to your lamp list you may find that No. 10 circuit has 51 lamps of the so called 2,000 candle power. For convenience, we will assume the current to be 10 amperes ; some systems use this current, others a little less. Again, suppose the circuit to be 10 miles long of No. 6 B. & S. wire. The resistance of one mile of this wire, as before stated, is 2.088 ohms ; then 10 miles would equal 20.88 ohms. Now, using Ohm's law of E equals RxC, we have 208.8 volts, giving us the electromotive force required to overcome the resistance of the line circuit.

This 208.8 volts deducted from the total electromotive force of the circuit, 2,500 volts, leaves a remainder of 2,291.2, being the amount absorbed by the 51 lamps on the circuit. This would give an average of nearly 45 volts per lamp; just about the proper voltage when burning a 4½ ohm arc. In the calculation with which we are dealing it is, of course, necessary to take into consideration the 208.8 volts lost in the line. If we divide this 208.8 by the number of lamps on the circuit, it will give an average per lamp of a trifle over 4 volts ; this added to the average lamp voltage will make a total of 49 volts ; so that 49 is the constant to be used in our dealings with No. 10 circuit. We will now connect one side of our voltmeter to ground, and the other side to the positive side of the circuit. If we get a reading of 980 volts, for instance, and divide this by our constant of 49 volts, it gives us 20 ; which means, of course, that the ground lies between the 20th and 21st lamp on the positive side of the circuit. If now we connect to the negative side and ground, and get a reading of 1,520 volts, by bringing our constant into use we divide 1,520 by 49, which equals 31—locating the ground between the 31st and 32d lamp on the negative side of the circuit ; precisely the same result as with the first test, and proving beyond a doubt the correctness of the first calculation. We are about to put our instruments away and resolve to have that ground cleared the first thing in the morning, when our dynamo tender informs us that the machine on No. 10 is running very light ; he thinks there are some lights cut out on it, as he had just noticed it flash. Connecting our voltmeter between the ground and positive side as before, 980 volts is the result ; just the same as we had left it a few minutes ago. Connecting now to the negative and ground, we find our reading to be 540 volts, instead of 1,520 as before. Dividing 540 by the constant 49, gives us 11, showing conclusively that another ground has appeared on the circuit between the 11th and 12th lamp on the negative side. Now disconnecting the instrument from the ground and placing it across the terminals, instead of a reading of 2,500 volts, we get but 1,520 volts. This divided by 49 equals 31 lamps left burning on the circuit; 31 from 51, the total number, leaves 20 lamps cut out by the grounds.

The number of lamps cut out could have been calculated without taking the terminal potential, by simply adding the two ground readings and deducting their sum from the terminal potential previously obtained, and dividing the result by the constant 49. All central stations have or should have maps of their circuits, showing on what streets they run, and the location of the lamps. If such maps be at hand we take out No. 10 circuit map, and counting 20 lamps from the station on the positive leg we locate one ground, and counting 11 lamps from the station of the negative leg, we locate the other. Now, when we call the lineman, we do not simply tell him there are two grounds on No. 10, but we tell him to go to the corner of Twenty-first and B streets for one, and Fifteenth and A streets for the other. If the maps above referred to are not to be had, then you have to depend upon the lineman's knowledge of the lamps and circuits.

A short time ago I had a very peculiar case of ground to deal with ; it had been raining and storming for several days, and circuits without grounds were held at a premium. One of our day circuits of 50 lamps was reported out—not a lamp on the circuit burning. A test showed the circuit to be grounded. Linemen were sent out on the circuit, but after tracing it from one end to the other, failed to find the trouble. The the machine was kept on the circuit all the time, running at 10 amperes, on almost a dead short circuit. When the first lineman failed to find the trouble another was sent out with the same result. Things were becoming interesting. I took the voltage of the circuit and got a reading of 40 volts—about that, I don't quite remember the exact figures—between the positive side and ground, about 13 volts ; between the negative side and ground, about 27 volts, showing, as had been reported, that every lamp on the circuit was out. By the method described in locating a short circuit on trunk lines, I determined the number of feet of wire from the station to the ground on the positive leg, that being the nearest one to the station, and with a lineman started out to find the cause of all the annoyance. I spaced the distance off with my eye as near as I could, and in 15 minutes from the time we left the station the 50 lights were shining forth in all their brilliancy, and the innocent telephone wire was credited with another knock out. The other ground was found a little later, where the voltmeter had located it.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. William T. Johnson, Secretary and General Manager of the Carbon Light Company, of Louisiana, Mo., informs us that, on the first inst., the Company was purchased by Mr. Charles B. Crosthwait, who will hereafter manage the same. Mr. B. S. Reynolds was appointed Superintendent, and assumed charge on the first.

At a recent meeting of the stockholders of the National Gas and Water Company, of Chicago, the following Directors were elected : H. C. Rew, C. D. Hauk, Irwin Rew, E. E. Morrell and N. A. McClary. The Directors subsequently perfected the following organization : President, Henry C. Rew ; Vice-President and General Manager, Charles D. Hauk ; Treasurer, Irwin Rew ; Engineer, E. E. Morrell ; Secretary, N. A. McClary. The Company is in excellent condition.

Freed from its recent entanglements, and animated by the progressive spirit of its new proprietors, the Pulaski Gas Light Company, of Little Rock, Ark., has this season completed the laying of 5½ miles of main pipe, the diameters of same showing nothing less than 4 inches, while a goodly share of the extensions called for the placing of mains of 10, 8 and 6 inch diameters, respectively. These extensions not only reach new territory, but greatly increase the gas supply in the business portions of the city. During December the output exceeded the estimates of the most sanguine of the Company's proprietors, and more than justified the liberal expenditures made in the direction of popularizing the use of gas for cooking and heating. The present outlook for the Company is a prosperous future. Its officers are : President. James A. Fones ; Treasurer, Oscar Davis ; Secretary, J. T. Pullen ; Cashier, Renton Punnah.

The Newport (Ky.) Light Company has changed hands, General Hickenlooper, the Kirk estate, John A. Williamson, Lee Hawthorne and others having parted with their stock to Mr. G. R. Harms and his friends. Mr. Harms, who was formerly Mayor of Bellevue, and who has been seeking control at Newport for some time back, has been elected President. The Directors are : G. R. Harms, W. H. Harton, W. A. Goodman and L. C. Weir. The Company will continue to purchase its gas, for the present at least, from the Cincinnati Gas Light and Coke Company.

The authorities at Braintree, Mass., have taken the initial step towards engaging the town in the operation of a municipal electric lighting plant, from which they also propose to supply current to the shopkeepers, householders, and so on.

We are indebted to Mr. William Blinks, President of the Michigan City (Ind.) Gas Company, for a copy of the circular announcing a reduction in the gas rate, issued on October 20th, 1892, by Mr. M. Romel, The Company's Secretary and Treasurer. We herewith reprint the same, in the belief that (although the announcement does look to be a tardy one), our readers will be pleased to learn of the progressiveness of their Michigan City brethren. The circular is : "The Michigan City Gas Company gives notice that from and after October 1, 1892, a reduction in the price of gas will be made as follows : To all consumers using in any one month less than 5,000 cubic feet, $1,60 per 1,000, with 10 cents per 1,000 discount, or $1.50 net ; 5,000, and less than 10,000 cubic feet, $1.50 per 1,000, with 10 cents per 1,000 discount, or $1.40 net ; 10,000 cubic feet and upwards, $1.40 per 1,000, with 10 cents per 1,000 discount, or $1.30 net. Gas for fuel or power, when metered separately, will be $1.30 per 1,000, with 10 cents per 1,000 discount, or $1.20 net. To obtain the above discounts all bills must be paid on presentation by the collector, or at the office of the Company, on or before the 10th of each month for the previous month's consumption."

At the annual meeting of the Chico (Cal.) Gas Company no change was made in the executive management.

Patrick Cosgrove, who had been an efficient and trusted employee of the New Brunswick, N. J., Gas Company for the past 15 years, died at his home in that city about a fortnight ago.

The authorities have granted an ordinance to the proprietors of the East Portland (Oregon) Gas Light Company, permitting them the "freedom of the city" in the matter of putting down gas mains in the eastern section of the city.

The youthful enthusiasts, at Vallejo, Cal., who have been enjoying themselves by smashing the globes encasing the public arc lights, will likely hereafter restrain their desires in that particular direction. Four of the offenders were recently brought before Judge Lamont, with the result that each was fined in the sum of $5.

We are indebted to Mr. James D. Perkins for the following particulars respecting the career of the late Mr. Daniel W. Job, who had been associated with Mr. Perkins in the gas coal business some years ago:

Intelligence has just been received of the death, at Bermuda, on Dec. 28, of Mr. Daniel Ward Job. Deceased, who was born in St. Johns, Newfoundland, on Jan. 1, 1840, was educated in Liverpool, England, and came to the United States, in 1856, to enter the office of his brother-in-law, Mr. James P. Melledge, the then well-known commission merchant and importer of gas coals, in Boston. He subsequently became, respectively, a member of the firms of J. P. Melledge & Co., Bird, Perkins & Job, and Perkins & Job. Upon the dissolution of the latter firm, in 1878, he formed the copartnership of Daniel W. Job & Co., associating with him Messrs. C. F. Stratton and George B. Little. Failing health compelled the relinquishment of the cares of business in January, 1887, and he has since lived in retirement at South Walpole, Mass., making occasional winter trips to Bermuda for the rest and recuperation which that climate proffered him. His death was not unexpected, the precarious condition of his health for the past five years warning his friends that his departure might be made at any time. Mr. Job was not what would be considered an active business man, his temperament and education rather inclining him to a professional life; but his strict integrity and devotion to the highest principles of mercantile honesty won for him the respect and esteem of all with whom he came in contact. His wife, formerly Miss Susie Adams, daughter of the Reverend Nehemiah Adams, D.D., the well known pastor of the old Essex street Church, Boston, survives him.

Engineering notes that, judging from the annual (1891) Parliamentary returns (issued towards the close of December) relating to the gas undertakings of the United Kingdom, the Companies have not yet been seriously affected by the adoption of the electric light, and then goes on to say: "Indeed the Gas Companies still continue to be steadily progressive and fairly remunerative. The number of public Companies [those directly amenable to Parliamentary regulation] last year was 410, as compared with 405 the previous year and 394 in 1889, and the total capital sunk in gas undertakings has risen, frum $299,390,000 in 1889, to $318,100,000 in 1891. About two thirds of this large total, $205,720,000, represents the capital belonging to the public Companies, the remainder being the capitalized value of the undertakings belonging to local authorities. Both classes of undertakings exhibit an increase in business. The number of cubic feet produced by the Companies last year was 70 thousand millions, as compared with 67 the previous year and 61½ in 1889. There was even a larger increase in proportion in the number of cubic feet produced by the local authorities. Customers do not increase in a like degree, although in 1891 there was an addition of 55,759 to the number of consumers supplied by the two classes of undertakings. An addition of 14,700 was made to the number of lamps erected for the illumination of public roads. The gross receipts of the Companies increased during the year by rather more than $5,000,000, and the quantity of coal carbonized by 977,000 tons. Owing to the growth of expenditure, net profits have fallen from an average of 23.42 cents per 1,000 cubic feet, in 1888, to 18.30 cents, and the average dividend has consequently fallen to 8¾ per cent. in 1891, from 8¾ per cent. in 1889."

The bachelor set has received a great dual setback in the shape of the recent apostacy from celibacy of two well-known and formerly single-minded men of St. Louis. It was in the nature of things that one of the recalcitrants should join in the ranks of the married, for Mr. Daniel Renouard Russell was always an admirer of the gentler sex, hence it was without extraordinary emotion that we read the announcement of his union, to Miss Everett Bessie Kennerly, daughter of Mr. and Mrs. William Clark Kennerly, of St. Louis, the ceremony having taken place on January 10. The newly-wedded have since reached New York in safety, and ex-Bachelor "Dan." is in the roundest moon stage of the proceedings, if one may judge by appearances. May their tide of good luck and prosperity ever be on the rise.

But what shall be said of the other St. Louis man, whose transition from the state of single blessedness took place without a warning. You all know John Dell, the man who never showed a bit of sentimentality, but who never lost a friend, "just the same." Is it within the pale of your imagination to conjure up the picture of bluff and hearty John, with dressing gown clinging to his vest, and his slipper-encased feet resting on an ottoman, or a stool, or something of that sort—all this about 9 P. M., mind you—in his own household, ever and anon fondly turning his glance, etc.? Well, we should softly murmur. It is all true, for he was united in marriage, on the evening of December 21st, to Miss Mary Wash, at the residence of the bride's mother, No. 5009 Bell avenue, St. Louis. The bride is a charming member of one of the most respected families of that city, and her capture adds a new force to her husband's guiding motto, "I always win." They now are enjoying the balmy air of the Pacific Coast, while St. Louis is shivering in a vain attempt to find a cause for the great scarcity of heat units in her surrounding atmosphere. All joy to them, for a squarer man than John Dell is not to be found.

The Taunton (Mass.) *Gazette* is responsible for the suggestion that eventually the manufacturing plant of the Taunton Gas Light Company will be located on the plot owned by the Company in the adjoining suburb known as Weir village. Whether so or not, the Company is putting up a coal storage shed there now; nor can there be any doubt of it that should the Company decide to remove to Weir, which cannot be over one mile south of the Taunton city line, it would be well served in respect of the conveniences that go to make up an eligible site for a gas works.

The Committee of Councils, of Richmond, Va., intrusted with the task of examining into the most available system of water gas making for the auxiliary plant of that general nature recently ordered to be installed at the municipal gas works, is attending very thoroughly to its duties. Chairman Gunn and Supt. Adams, when appealed to for a forecast of what the decision was likely to be, declined to make a statement, an unwillingness that is all the more understandable when it is remembered that the amount appropriated for the proposed annex is only $25,000. While we are not sure that a water gas plant will be of any particular advantage, pecuniarily, in a situation so favorable to the production of coal gas as Richmond is, we are quite certain that, if Richmond must have water gas, the appropriation is too absurdly small to enable the water gas builders to show their product at anything like its best.

Amariah A. Taft, a prominent and wealthy resident of Milford, Mass., died suddenly in that city on the 10th inst. He was a Director in the local Gas Company.

Mr. Moore, of the Michigan Legislature, has given notice of a bill to establish an Electric Light Commission for the city of Detroit, the said bill being in the nature of an additional chapter to the charter of that city. It provides that the Mayor, Controller, President of the Board of Public Works, President of the Police Commission, and President of the Fire Commission, shall constitute the Commission. The Mayor is to be President thereof, and the Controller may act as Secretary, or a Secretary may be appointed outside the Commission. The Commission is authorized to buy lands, erect or purchase buildings, erect towers, poles, wires, lamps, lay pipes and wires underground, etc., to properly conduct the business of public lighting by electricity. If the Common Council directs the Commission to build an electric plant, the necessary authority is given to issue bonds to meet the expense thereof. When the Commission is organized and prepared so to do it may erect an electric light plant and go on with the work of public lighting; secondly, it may erect, own and control towers, wires, poles and lamps, and have the public lighting done by private firms or corporations; or, thirdly, the public lighting may be done by contract, as at present, but under the supervision of the Commission.

At the annual meeting of the shareholders of the Brooklyn (N. Y.) Gas Light Company, held about a fortnight ago, the retiring Board of

Directors was re-elected. Last week, however, Henry H. Rogers resigned from the Board, which is taken to mean that Rogers and Addicks are like unto oil and water, in that they cannot coalesce.

AT the annual meeting of the Peoples Gas Light Company, of Jersey City, N. J., the following Directors were chosen: T. Morris Perot, T. H. Williams, H. A. Coursen, George W. Conklin, Freeman A. Smith, A. A. Lutkins, Frank Stevens, Hamilton Wallis, and J. J. Voorhis. The Directors named the following officers: President, T. Morris Perot; Vice-President, T. H. Williams; Secretary and Treasurer, E. R. Case.

THE works at Huntington, L. I., that were originally under the control of Mr. Olney and his backers, but which have never got beyond a partial state of completion, are to be finished and put in operation this year. We believe that Mr. Leadley, of Hanlon & Leadley process fame, is the prime mover in the present activity, and if such is the case it may be taken for granted that Huntington will speedily have a gas works in fact as well as in name. This place is a very popular summer resort, and maintains several hotels, one or two of which are close to first class. It also has quite a numerous permanent population. We hope to have some account before long from Mr. Leadley respecting progress made.

THE Pittsburgh (Pa.) Gas and Electric Fixture Company has been incorporated. It is capitalized in $10,000.

THE proprietors of the Rockville (Conn.) Gas and Electric Light Company have added to their main offices a room for the exhibition of appliances for cooking and heating by gas.

A MAN named Faye, a contractor residing at 429 Yonge street, Toronto, Canada, some time ago had occasion to visit the town of Waterloo, his business obliging him to remain there for some days. Through some means or another (the details of the happening to hand are very meager) he was prostrated by inhaling illuminating gas, and now sues to recover from the Waterloo Gas Company damages in the sum of $10,000. He alleges the Company's negligence was responsible for his injuries, and he brings the suit in one of the Toronto courts. The defendants demur to this place of trial, and have moved that the hearing be had at Waterloo—the place where the accident happened.

IT is said that the proprietors of the Milwaukee (Wis.) Gas Company will this season order the erection of an additional plant, but nothing definite, that we have been advised, has been agreed upon. It is also reported that Congressman Mitchell's holdings in the Milwaukee Company have been disposed of to a syndicate, the ostensible head of which is said to be Mr. F. W. Montgomery.

THE Pacific Gas Compressing Company has been incorporated at San Francisco, Cal., by Messrs. W. P. Redington, G. W. Fletcher, F. W. Marvin, L. J. Cowgill and E. J. Calley. The concern is capitalized in $100,000.

THE following is from the Chicago *Times* of the 14th inst.: "The Peoples Gas Light and Coke Company came in conflict with Judge Horton yesterday and was badly worsted. Some time ago the Court appointed a Receiver for the Neufield Manufacturing Company. When the Receiver took possession of the premises at 39 South Halsted street, the first man to put in appearance was the Gas Company's collector. He had an old bill for $20.19, which he demanded should be liquidated at once. On refusal by the Receiver, the Company took its usual means of compelling payment by shutting off the gas. Notice was then served on the Company that Judge Horton would be applied to for relief in the matter. When the matter came up the Gas Company's attorney asked the Court to require the Receiver to deposit $25 for the meter and give a bond to pay the bills. 'I'll do nothing of the sort,' said the Court. 'Don't you know turning off the gas is no way to compel the payment of a bill? Such action is unwarranted and would ruin any business. In interfering with the Receiver appointed by this Court you are interfering with the Court.' 'Will your honor enter an order requiring the Company to turn on the gas?' asked the attorney for the Receiver. 'I haven't the power to do that, but I will authorize the Receiver to take a wrench and turn on the gas.' 'It is locked,' pleaded the Receiver, 'and I can't turn it on.' 'It can't be locked so securely that there are not enough locksmiths in this city to unlock it. You may get a locksmith to turn on that gas, and then if the Gas Company attempts to turn it off apply to me and I will give you an injunction at once restraining it from doing so. We will see whether the Gas Company is greater than this Court.'"

FROM the Court's order to the Receiver, as to the using of a wrench for the purpose of turning on the gas from a cut out meter, we respectfully submit that the Company had greater knowledge about some things than the Court.

THE proprietors of the Portsmouth (N. H.) Gas Company have suffered great loss on their gas mains, through the slovenly manner in which the city contractors conducted the laying of the new mains for the local water supply. The actual damage so far, from a monetary point alone, is not less than $2,500, to say nothing of the inconvenience occasioned to gas users from defective pressure and the risk of explosions caused by the frequent escapes of gas—a danger all the more radical from the severe frosts of the present winter season.

WE are in receipt of a very handsome calendar, from the Western Gas Construction Company, of Fort Wayne, Ind.

THE Leominster (Mass.) Gas Light Company has declared a semi-annual dividend of 2 per cent.

AT the stockholders' meeting of the Hartford (Conn.) City Gas Company the following Directors were chosen: John P. Harbison, Francis B. Cooley, James L. Howard, Henry K. Morgan, George Roberts, Hugh Harbison, Atwood Collins, Nathaniel Shipman and Rodney Dennis.

AT the annual meeting of the Equitable Gas and Electric Company, of Utica, N. Y., held in New York city about a fortnight ago, Messrs. P. V. Rogers, H. Keene, W. H. Gebhard, E. J. Jerzmanowski, John Fox, E. Balthaser, A. R. Pick, J. P. Miller and Casimir Tag were elected a Board of Directors. From the annual reports submitted by the Superintendent, Mr. E. A. Pinkney, it was shown that the Company's business was progressively profitable. The showing on account of the use of gas for purposes other than lighting was very marked.

THE annual report of the Metropolitan Gas Light Company, of Brooklyn, N. Y., places the liabilities at $273,793.73, and the assets at $1,511,672.43.

AT the annual meeting of the Chicago Gas Company the following Directors were chosen: C. K. G. Billings, E. J. Jerzmanowski, George O. Knapp, W. J. Campbell, L. A. Wiley, E. C. Benedict, John B. Cohrs, Walton Ferguson, C. K. Wooster, E. A. McGuire and F. S. Winston.

THE Directors selected the following executive management: President, E. J. Jerzmanowski; First Vice, C. K. G. Billings; Second Vice, George O. Knapp; Secretary, C. K. Wooster.

THE new management of the Niagara Falls (N. Y.) Gas Light Company is as follows: Peter A. Porter, Lawrence Pettibone and L. A. Boore, of Niagara Falls, A. E. Perkins, Wareham Whitney, Hayward Hawks and H. L. Brewster, Directors; President, Harry L. Brewster; Vice-President, Peter A. Porter; Treasurer, A. Erickson Perkins; Secretary and Superintendent, L. A. Boore.

THE annual meeting of the Newport (R. I.) Gas Light Company resulted as follows: Directors, Messrs. Henry Bull, James C. Swan, Philip Rider, Thomas A. Lawton and Andrew K. Quinn; President, Henry Bull; Secretary, Thomas A. Lawton; Treasurer, Andrew K. Quinn.

THE bondholders of the Metropolitan Gas Light Company, of Elizabeth, N. J., being dissatisfied with the net results of the Receiver's custody and the outcome of the sheriff's sale, have succeeded in obtaining an order for an "expert accounting" of the books of the Company, the same to be made before Vice-Chancellor Van Fleet.

THE officers chosen by the Belleville (Ills.) Gas Light and Coke Company are as follows: Directors, Edward Abend, Henry Kircher, George Gauss, Solomon Mueller and John A. Day; President, Edward Abend; Secretary and Treasurer, Richard Wangelin.

THE cooking and heating stove department of the San Francisco Gas Light Company is located at No. 16 Post street, and is managed by Mr. L. A. Mitchell, who is an adept in the practice of convincing his visitors of the value, utility and economy of gas as a domestic aid. It is likely that the Company will this spring arrange a series of public lectures, practically illustrated, for the purpose of showing what can be done by gas in the kitchen, the lectures to be given and the practice to be demonstrated by Mrs. E. M. Hinckley, the well known expert in this line on the Pacific slope.

NOW does the complaint clerk have his time occupied and his temper tried.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

EDITOR—Jos. R. Thomas, C.E.
ASST. EDITOR—T. J. Cunningham.
MANAGER—C. E. Sanderson.

MONDAY, JANUARY 23, 1893.

The Market for Gas Securities.

The market for city gas shares was very animated during the week, the feature being an increase of upwards of 10 points in Consolidated, which opened to-day (Friday) at 139¾ bid, against 129¾ on Friday last. It is said that an increase in the dividend rate will be ordered on the 23d (the occasion of the annual meeting), and while the Company could, no doubt, at its present rate of earning, easily and safely make a substantial concession to its shareholders, the policy of the thing, with the personnel of the present Legislature in session duly considered, seems more than questionable. The book value of the shares can be made, through an increasing value in the quotations, to represent the interest increase; and if the Company is so rapidly growing rich it might better, all things considered, voluntarily decrease the gas rate. Equitable is strong on an extra return to the shareholders (the rate was raised to 3 per cent. quarterly, and the dividend for last quarter is payable to-day), and Mutual remains as before. Standard preferred is in good demand, as also is the common, which is quite in the natural order, judging from the great increase in the Company's business.

The Brooklyn situation is still remarkable for its uncertainty and vagaries. Mr. Addicks has likely not secured even a one-third interest in the Metropolitan, and Mr. Jourdan, of the Fulton-Municipal, is posing *a la Machiavel*. Mr. Rogers has resigned from the Brooklyn Directorate, but he still can keep a close eye on its internal economy through the vision and other senses of his understudy, who never resigns anything. As we take it, all this bluster about a rate war in the spring is *bluster*. In fact, we believe the only Company in Brooklyn that would really institute and then enjoy such a proceeding is the Equity, whose managers are in the swim for all it is worth. The works are all ready to make gas now. In the meantime all classes of Brooklyn gas shares are steady, at prices that are fully up to their normal value. Something definite ought to be known about the Brooklyn situation in a fortnight at the furthest. Chicago gas opened to-day at 90½. Bay State is dull, at 56 to 57. Lacledes are higher, the common selling at 25½ and the preferred at 74. Consolidated of Baltimore is bid for at 59¼. The general outlook is very favorable.

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